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THE MAGNETIC STATE OF THE EARTH
(According to the Magnetic Maps for 1880.0 published
by the German Naval Office)
by

G. V. Quintus Icilius



Translation of "Der Magnetische Zustand der Erde nach
den von der Deutschen Seewarte herausgegebenen mag-
netischen Hamburg, Germany, Karten fuer 1880.0", Archiv
der Deutschen Seewarte, IV Jahrgang, No. 2, 1881, pp. 1-2.

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THE MAGNETIC STATE OF THE EARTH
(According to the magnetic maps for 1880.0
published by
German Naval Office)

Calculated by G. v. Quintus Icilius
Professor In Hannover

Publication of the maps mentioned in the title has made it possible to make the first continuation of the foundations for the Earth's magnetism establish by Gauss in the general theory of Earth magnetism. The numerical values of the "Earth magnetism element" represent the magnetic state of the Earth as occurred at the time of publication which Gauss used in his calculations which is about the year 1830. A new calculation based on the maps valid for 1880, therefore, makes it possible to express the change which has occurred over the last 50 years in numbers, but of course, only within the liability limits of the maps themselves.

The Gauss calculations were carried up to fourth order. The calculation performed up to fourth order quantities and expanded to approximately the fifth order has primarily been suppressed (primarily because of the direct comparability of both numerical series). It seemed doubtful whether by means of such an expansion one would obtain a substantially better agreement between theory and the maps used, compared to the agreement achieved by Gauss (sic). The following comparison of the values of declination, inclination and horizontal intensity calculated backwards from the new elements and the values taken from the maps used in the calculation seems to justify this doubt.

In other ways the calculation is done completely according to the method used by Gauss. Only the initial data (of the method) are taken from 10 parallel circles instead of seven, and the numbers for the intensities are referred in absolute scale just like in the maps of the nautical observatory.

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In the following table of the numerical values of the 24 elements, we also add the values calculated by Gauss, after recalculating the latter with the reduction factor 0,0034941 given in the general theory of the Earth's magnetism, article 34, to an absolute scale.

| | 1880 | 1830 | | 1880 | 1830 |
|-----------------|----------|----------|-----------------|----------|----------|
| $g^{1,2}$ | +8,33928 | +8,23477 | $g^{2,3}$ | -0,04284 | +0,00172 |
| $g^{2,4}$ | +0,05507 | -0,07708 | $g^{3,4}$ | -0,82858 | -0,25575 |
| $g^{3,5}$ | -0,10790 | -0,06598 | $g^{4,5}$ | -0,20615 | -0,16000 |
| $g^{4,6}$ | -0,18968 | -0,58035 | $\lambda^{1,2}$ | -0,12435 | -0,18631 |
| $g^{1,3}$ | +0,27686 | +0,91106 | $\lambda^{2,3}$ | -0,00581 | -0,07955 |
| $g^{2,5}$ | -0,51980 | -0,50635 | $\lambda^{3,4}$ | +0,14439 | +0,14876 |
| $g^{3,6}$ | +0,38543 | +0,42956 | $g^{1,4}$ | -0,05289 | +0,00488 |
| $g^{4,7}$ | -0,64693 | -0,55291 | $g^{2,6}$ | +0,10284 | +0,06909 |
| $\lambda^{1,4}$ | -0,61920 | -0,62456 | $\lambda^{2,5}$ | -0,06812 | -0,06552 |
| $\lambda^{2,6}$ | +0,06806 | -0,02107 | $\lambda^{3,6}$ | +0,06755 | -0,00062 |
| $\lambda^{3,7}$ | +0,08637 | +0,16700 | $g^{1,5}$ | -0,00882 | -0,01442 |
| $\lambda^{4,8}$ | -0,14340 | +0,22402 | $\lambda^{4,7}$ | +0,01027 | +0,01109 |

The values of the magnetic potential $\frac{V}{R}$ on the Earth's surface are represented by curves in the maps just like in the atlas of the Earth's magnetism of Gauss and Weber, but the number of curves is much smaller than assumed there. The dotted lines which apply for the year 1830 are not directly copied from the atlas because they represent values somewhat different from those shown there, and this is why the table accompanying the atlas for the calculated values was constructed again.

There is a substantial change in the curves especially in the northern Polar regions because here the value of the magnetic potential over the 50 years became much larger. For the maximum, whose position has shifted somewhat, the increase is about 9.3%. In the southern hemisphere, the absolute value of the minimum has increased somewhat but only by about 0.7%.

The magnetic moment of the Earth in this time seems to have experienced a substantial increase because from the new elements we find $= 3.4080.R^3$, whereas in 1830, the value was $= 3.3092.R^3$, that

is about 3% less.

Finally, as for the direction of the magnetic axis of the Earth, in 1830, it was parallel to the Earth diameter

from $77^{\circ}50'$ northern latitude and $296^{\circ}29'$ eastern longitude to $77^{\circ}50'$ southern latitude and $116^{\circ}29'$ eastern longitude, according to numbers calculated for 1880, it is parallel to the Earth diameter ;from $78^{\circ}31'$ northern latitude and $294^{\circ}3'$ eastern longitude to $78^{\circ}31'$ southern latitude and $114^{\circ}3'$ eastern longitude, and therefore, has not changed much.